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Analysis and Design of Highway Monitoring System Based on MAS

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Abstract

The highway monitoring system is an open, intelligent, distributed complex information processing system. Analysis of the agent (Agent), Multi-Agent System (MAS) and Agent-oriented software design (AOP), the framework of the MAS-based highway monitoring system, and its composition were analyzed, and discussed the various types of agent of the function and structure, to design a Universal Agent template. Finally, the Agent Communication Language Agent Description Language is discussed.

Key words: highway monitoring system; multi-agent system; agent; software design

1. Introduction

Highway monitoring system is part of the Highway Traffic an important component of the electrical and mechanical systems, monitoring freeway traffic flow and traffic conditions on key points, weather detection, timely control of the critical sections of the implementation and management, the timely detection of unusual circumstances and to take emergency measures to ensure high-speed highway, security, comfort and economic operation.

Highway monitoring system can be divided into its function, the information collection system, information processing systems and information systems; each system is composed by many subsystems with different functions. Network-level monitoring system, it can be divided into regional monitoring center and sections of two monitoring sub-centers. System is distributed in space, where information processing system

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located in the control centers and monitoring sub-centers, information collection and information dissemination systems are located in the center of the monitor, monitoring sub-centers and along the highway. Information collection and release of a variety of forms, data structures, data formats are different and huge amount of information, and each subsystem with each other in close collaboration in order to complete monitoring and control functions of the system. The same time, the information processing system for intelligent processing of large amounts of information and use of expert knowledge and experience, with the help of intelligent decision support technology to develop the road network, traffic management and control strategies. Therefore, highway monitoring system is an open network environment, an intelligent, distributed complex information processing system.

Currently, the highway monitoring system software development using object-oriented software design (Object-of Orient Programming, OOP) technology, OOP is a very mature software design, but such an open highway monitoring system, intelligent distributed complex information processing systems, OOP, there are a number of limitations. For the subject (Agent) software design (- Agent-Orient Programming, AOP) as a new computing to create the Agent is given a similar awareness and ability, a greater particle size, higher intelligence, certain independence from the entity (as opposed to object), is more suitable for open, intelligent distributed complex applications. Therefore, based on MAS technology to build the highway monitoring system.

2. Multi-Agent System (MAS) and Agent-oriented software design

2.1. The agent.

Agent is the agent to run in a particular environment, and can respond to changes in the environment, flexible, independent action to meet its design objectives computing entity; it has the following four basic features. Autonomy (autonomy): the Agent can be run in the absence of a person or other agent directly intervene in the case of some control, but also for their actions and internal state; social (social ability): Agent and Agent (may also be people) through some kind of agent communication language for social communication; reactivity (reactivity): Agent can understand the surrounding environment, and changes in the environment to make real-time response; initiative (pre-activeness): Agent not only their environment to make reaction by accepting some of the information, the performance of purposeful behavior. In this study, the agent as a software entity to understand, that Agent is in a specific environment, continuous, self-running software entity, usually together with other actors jointly solving problems.

2.2. Multi-agent system MAS.

MAS is the multiple executable Network Computing Agent composed of a collection, each Agent is independent and can function in itself and the surrounding environment, and can communicate with other Agent. Multi-agent technology in the expression of the actual system, each agent communication, cooperation, mutual solutions, coordination, scheduling, management and control of expression of the structure, function and behavior characteristics of the system. MAS, Agent is an entity of independent behavior, decisions and control their own behavior, but also can work together effectively with other Agent, and by the coordination between the Agent and mutual cooperation based on internal knowledge and external incentives to solve large-scale complex problems. MAS technology in many fields have been applied, including traffic management systems [1,6], decision support systems [2,3], information collaboration system [4], e-commerce and network information retrieval [5] and other fields.

2.3. Agent-oriented software design.

Experienced a process-oriented approach to software development (third-generation language 3GL, such as Fortran, C), entity-oriented approach (fourth-generation language 4GL, such as SQL), object-oriented methods (fifth-generation languages such as SmallTalk , the C + +) At present, software development methodology is oriented to the main method (the sixth generation language) forward.

AOP OOP methods of a special case (of specialization), the internal state of the object OOP AOP provisions of the state of mind (Mental State), such as knowledge, beliefs, ability, commitment to goals, each mental state has a certain meaning. Messaging between the objects to be replaced based on the communication primitives of the language movement, such notice, request, promise, refuse, and so on. Relative to the terms of the Object, Agent is a particle size greater, more intelligent, has certain autonomy of the entities, the two have much in common, such as encapsulation, inheritance and polymorphism. In short, the AOP has easy software to create interoperability strong features, a new, powerful method to solve large-scale software engineering.

3. System with various Agent

Based on the face of Agent and MAS analysis and monitoring system, the MAS-based highway monitoring system structure shown in Figure 1.

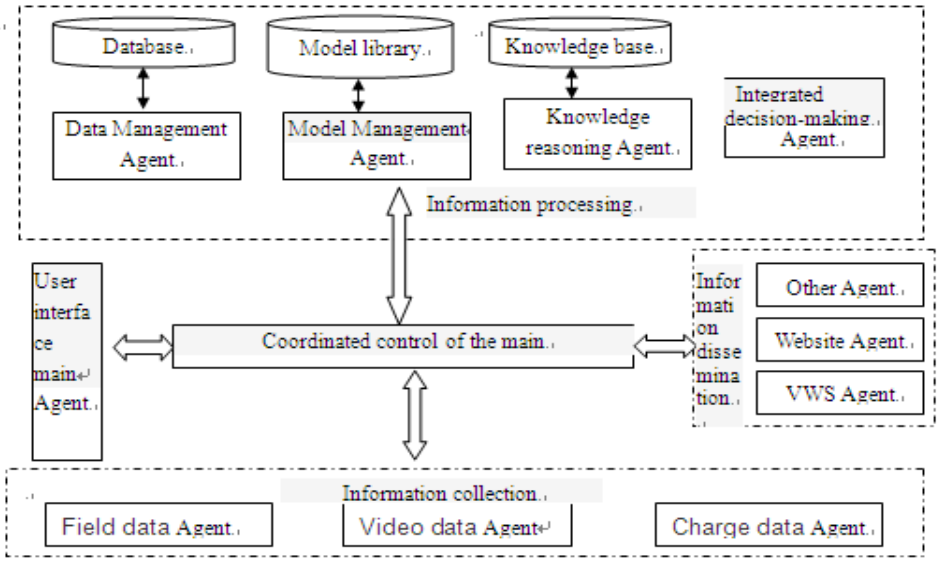

Figure 1 A monitoring system based on MAS highway structure

Collected by the Information Agent, Information Agent, Information Agent, the Agent and coordination of user interface control of Agent five classes Agent. Information Collection Agent is mainly responsible for monitoring the acquisition and transmission of system information of all kinds, is divided into the types of information collected field data Agent, the video data Agent and charge data Agent. Field data Agent is mainly responsible for vehicle detection, meteorological monitoring, emergency telephones, variable message signs loaded with farm equipment at the collection of traffic data, meteorological data and device status data, and store them in the server database; Video Agent is mainly responsible for the field of video surveillance

video data acquisition system and charges the CCTV system; charge data Agent is mainly responsible for the highway network within each toll station entrances and exits, traffic flow data collected from the toll system. Discussed above are collected by the Information Agent to complete the automatic collection of information, and part of the required manual collection of information (such as: conservation of the road traffic incident information, and temporary to be published promotional information, etc.) completed by the man-machine interface Agent.

Information Processing Agent is mainly responsible for the maintenance, management, and intelligent processing of information collected by the system as well as traffic management and control system to solve. Data Management Agent is responsible for database query, entry, modification, data extraction functions; Model Management Agent is responsible for the model library management and maintenance work, a combination of the model and the model run; knowledge reasoning agent to complete the knowledge base maintenance and knowledge-based reasoning work; integrated decision-making Agent for complex problems in the monitoring system (such as: road network coordination and control, emergency rescue strategy generation, etc.) and comprehensive utilization of the database, model base and knowledge base resources to achieve qualitative and quantitative combination of intelligent decision .

The Information Agent is responsible for system information released, including release in the way of variable message signs (VMS), the site the way, radio, cell phone text messages and other real-time traffic information.

Agent and coordination of user interface control Agent for the Special Agent in the main software design (Agent-Orient Programming, AOP) system is also essential Agent. User Interface Agent in the system act as the role of the man-machine interface, it is to emphasize the traditional human-computer interaction interface at the Agent's autonomy and learning in the decision-making process and user interaction through continuous learning, certain characteristics of the user's knowledge, autonomy in decision-making process to make the strategy consistent with the user's will, thus affecting the manager's thought processes, and achieve a high degree of man-machine co-intelligence. Agent user interface features include input and display all kinds of information and accept user interaction command and interpretation of the implementation, acceptance of the whole system monitoring commands.

Coordination Control Agent is the core of the system, responsible for planning coordination system within the main body of the run, monitoring the progress of the work of all the main state. The same time, it maintains a system of all the main capabilities, status and address information database, use this database to the other actors in the system offers a variety of essential services, such as: name service, inquiry service, subscription services and the main survival of services. Coordinated control agent typically includes Planning (Planner), the task allocator (Task-the Distribute), Scheduler (the Scheduler), Coordinator (Coordinator), Monitor (the Monitor), constructor (Configurator), communication management module completion of the task.

4. System of Agent technology

4.1. Agent structure.

Agent architecture can be broadly divided into: the prudent Architecture (Deliberative Architecture), the response architecture (Reactive Architecture) and hybrid architecture (Hybrid Architecture) three. System on the face of all kinds of agent analysis, the Agent can be flexible hybrid architecture. Shown in Figure 2, each Agent including perception, action, reaction, modeling, planning, communication, decision-making module.

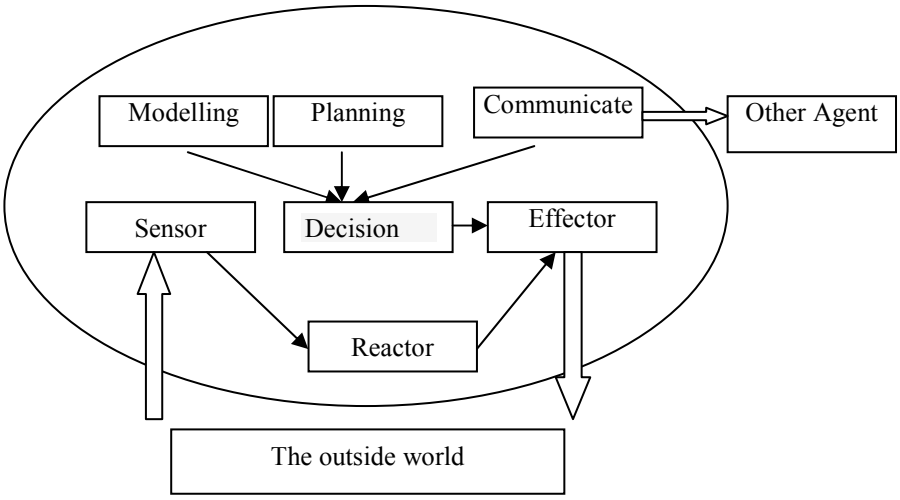

Figure 2 Agent Hybrid Architecture

4.2. Universal Agent template design.

System, all kinds of Agent achieve different functions and also a big difference in their own knowledge and ability of solving problems, such as the Agent of the information class is relatively simple, and coordinated control agent and integrated decision-making agent is more complex, therefore, all kinds of Agent are very different in its constructor. However, through the study of Agent, you can find all kinds of Agent there are also some of the same characteristics, such as communication, actuator, and mental status (Mental State) is the same, the difference is that decision-making strategy, they What action, and knowledge representation. Agent technology can define an Agent are the same core structure (agent kernel structure), an interface defined in the main kernel makes all kinds of Agent decision-making methods, function modules, etc. can be easily connected to the main kernel on. Agent kernel shown in Figure 3.

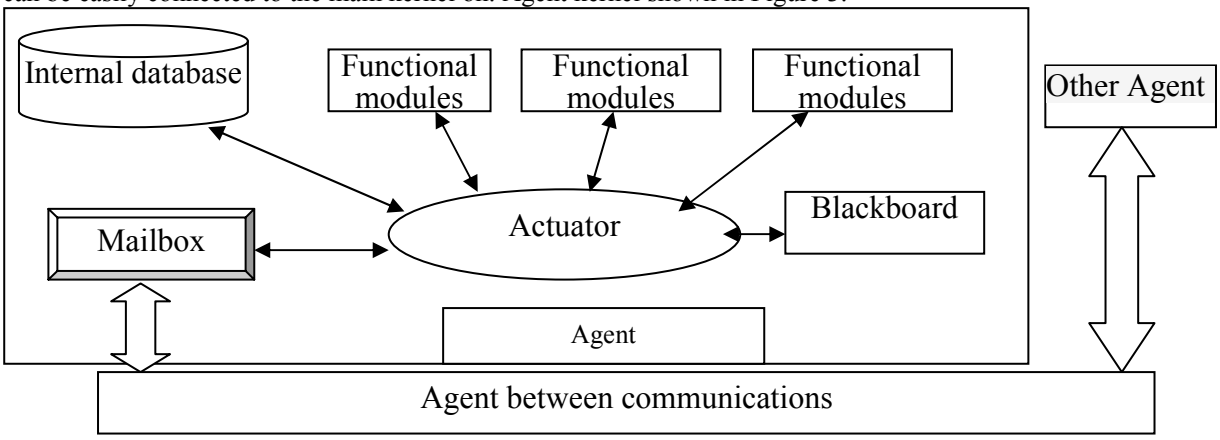

Figure 3 - Agent Kernel

Based on the above ideas, designed the system to achieve a Universal Agent template by the agent kernel and power

Module composition. Agent kernel internal database, mail, blackboard, actuator and other components. , The internal database that contains the Agent's own information, the target collection of the world model; E-mail agent and the environment and other Agent communication; blackboard to provide communication between the Agent within functional modules; executing agency to complete the message distribution function executive control of the module. Each functional module is an independent entity, the start of the actuator parallel execution, and coordinated through the blackboard. These functional modules can use different programming languages, data structures, support the same blackboard format can.

4.3. Agent Communication Language and Description Language.

Each Agent in the highway monitoring system must be through some kind of communication language to communicate with each other and collaborate. The syntax and semantics of information exchange between the main communication languages defined Agent specifications. KQML for (Knowledge Query and Manipulate Language) is now standard on the facts of Agent Communication Language, therefore, the system also uses KQML as an agent communication language.

In order to function modules can be easily connected to the Universal Agent module, and to facilitate the MAS configuration, communication and collaboration, system design of an Agent Description Language (ADL),. ADL describes the agent address, objectives, capabilities, resources, and Agent via ADL to create an internal database, the allocation of resources and the function module is loaded.

5. Conclusions

This paper presents the MAS-based highway monitoring system framework, constituted to explore the function and structure of various types of agent, designed on the basis of a General Agent template. Finally, Agent Communication Language and highway monitoring system based on the MAS agent description language. Realize intelligent highway monitoring system software, this study explored a new way, and also laid the foundation for the eventual realization of the system.

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